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SOLID SORBENTS FOR CO₂ CAPTURE FROM POSTCOMBUSTION GAS STREAMS

Background

According to the President's Global Climate Change Initiative as described in NETL's carbon sequestration technology roadmap and program plan, CO₂ capture from coal combustion systems is critical for the Department of Energy's CO₂ sequestration program. Current commercial CO₂ capture technology (e.g., gas absorption by solutions of carbonates and alkanolamines) is expensive and energy intensive. The cost of CO₂ removal from postcombustion gas streams is also expensive, and the majority of industrial plants do not recover CO₂ after combustion. It is important to develop low-cost processes that utilize materials with high CO₂ adsorption capacity, high selectivity for CO₂, high diffusivity, high rates of adsorption, and high rates of regenerability.

Primary Project Goal

The primary goal of this research project is to develop regenerable sorbents that can capture CO₂ from coal combustion systems and are superior to existing commercial technologies.

Objectives

The major objective of this work is to develop solid regenerable sorbents that have high rates, high selectivity, high regenerability, and high adsorption capacity for postcombustion CO₂ capture in suitable conditions. Specific objectives include:

- Evaluate the feasibility of sorbent preparation in commercial-scale unit and bench-scale reactor tests.
- Develop regeneration schemes to obtain a concentrated CO₂ stream at 60-80 °C.
- Optimize the sorbent formulation to improve sorbent performance.
- Conduct long-term tests to determine the chemical and physical stability of the sorbents.
- Study the effect of trace contaminants on the sorbent performance.
- Test the sorbent in a pilot-scale reactor unit.



NETL CO₂ sorbent extrudates prepared at a commercial facility (Süd-Chemie Inc.)

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PROJECT PARTNERS

Süd-Chemie Inc. (Louisville, KY)
Carnegie Mellon University
(Pittsburgh, PA)

COST

Total Estimated Cost
\$25,000 per year

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Accomplishments

During the project, solid sorbents suitable for CO₂ capture from coal combustion gas streams were developed. Liquid impregnated solid sorbents that capture CO₂ in the presence of water vapor at temperatures from 30–60 °C suitable for post combustion CO₂ capture were also developed. The sorbents showed better CO₂ capture capacities and lower regeneration temperatures than the conventional amine process. A large-scale preparation of the sorbent at a commercial catalyst company was conducted successfully, and the sorbent showed promising results during bench-scale flow reactor tests with simulated coal combustion gas streams. The sorbent has sulfur removal efficiency of 99% with good removal capacity. A U.S. patent has been awarded for the sorbent material and process.

Benefits

The majority of coal combustion power plants do not capture CO₂ since the current processes are very expensive. Development of a cost-effective CO₂ technology is necessary to achieve the President's Global Climate Change Initiative without increasing the cost of electricity from coal.

